

Claims

1. A fluid distribution module (1) for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device (11) comprising:

5 - a first chamber (12) having an inlet (13) for a liquid; and

- a second chamber (14) having an opening (79) closed by a hydrophobic membrane (78) and an outlet (15) for discharging the liquid,

wherein the first chamber (12) partially extends within the second chamber (14) and communicates therewith by an upper passageway (72), and the second

10 chamber (14) comprises a upstream portion extending above the passageway (14) and a downstream portion extending below the passageway (14), and

- a connecting structure (10) having at least a first and a second conduits (20, 21) defined therein, wherein:

- the first conduit (20) comprises a first end for connection to a discharge tube (7) from the treatment device and a second end connected to the inlet (13) of the first chamber (12) of the degassing device (11), and

15 - the second conduit (21) comprises a first end connected to the outlet (15) of the second chamber (14) of the degassing device (11) and a second end for connection to a blood return tube (6) to a patient.

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2. A fluid distribution module (1) according to claim 1, wherein the connecting structure (10) further comprises a third conduit (22) defined therein having a first end for connection to a post-dilution infusion tube (8) and a second end connected to the first conduit (20).

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3. A fluid distribution module (1) according to one of the claims 1 and 2, wherein the connecting structure (10) further comprises a fourth and a fifth conduits (23, 24) defined therein, wherein

- the fourth conduit (23a, 23b) comprises a first end for connection to a blood withdrawal tube (5) from a patient and a second end for connection to a first end of a pump hose (2) of a peristaltic pump, and

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- the fifth conduit (24; 24a, 24b) comprises a first end for connection to a second end of the pump hose (2) of a peristaltic pump and a second end for connection to a supply tube (4) to a blood treatment device.

- 5 4. A fluid distribution module (1) according to claim 3, wherein the connecting structure (10) further comprises a sixth conduit (25) defined therein having a first end for connection to an anti-coagulant tube (3) and a second end connected to the fifth conduit (24).
- 10 5. A fluid distribution module (1) according to one of the claims 3 and 4, wherein the connecting structure (10) further comprises a seventh conduit (26) defined therein having a first end for connection to a pre-dilution infusion tube (9) and a second end connected to the fourth conduit (23a, 23b).
- 15 6. A fluid distribution module (1) according to one of the claims 1 to 5, wherein the connecting structure (10) further comprises a first pressure-measuring chamber (17) having a first and a second compartments (47, 48) separated by a flexible membrane (42), wherein the first compartment (47) is connected to the first conduit (20), and the second compartment (48) has a measuring port (50) for
20 connection to a gas pressure sensor.
7. A fluid distribution module (1) according to one of the claims 3 to 6, wherein the connecting structure (10) further comprises a second pressure-measuring chamber (18) having a first and a second compartments (47, 48) separated by a
25 flexible membrane (42), wherein the first compartment (47) is connected to the fourth conduit (23), and the second compartment (47) has a measuring port (50) for connection to a gas pressure sensor.
8. A fluid distribution module (1) according to one of claims 3 to 6, wherein the
30 connecting structure (10) further comprises a third pressure-measuring chamber (19) having a first and a second compartments (47, 48) separated by a flexible membrane (42), wherein the first compartment (47) is connected to the fifth

conduit (24), and the second compartment (47) has a measuring port (50) for connection to a gas pressure sensor.

9. A fluid distribution module (1) according to claims 6 to 8, wherein the measuring
5 ports (50) of the first, second, and third pressure-measuring chambers (17, 18, 19) have a central axis (y, z, w), and the central axes (y, z, w) of at least two of the measuring ports (50) are substantially parallel.

10. A fluid distribution module (1) according to claims 6 to 8, wherein the central
10 axes (y, z, w) of the measuring ports (50) of at least two of the first, second, and third pressure-measuring chambers (17, 18, 19) are substantially perpendicular to a longitudinal axis (x) of the degassing device (10).

11. A fluid distribution module (1) according to one of claims 1 to 10, wherein the
15 connecting structure (10) has a periphery and comprises at least one socket (51, 52, 53, 54, 55, 56, 57, 58, 59) connected thereto, wherein the socket (51, 52, 53, 54, 55, 56, 57, 58, 59) has a recess for receiving one end of a tube (2, 3, 4, 5, 6, 7, 8, 9) and forms one end of one of the conduits (20, 21, 22, 23, 24, 25, 26) defined within the connecting structure (10).

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12. A fluid distribution module (1) according to claim 11, wherein the connecting
structure (10) comprises a first and second sockets (55, 56) forming the second
end of the fourth conduit (23) and the first end of the fifth conduit (24), wherein the
first and second sockets (55, 56) are so positioned that a pump hose (2) having
25 both ends received in the two sockets (55, 56) forms a loop that laterally extends within a plan from the connecting structure (10).

13. A fluid distribution module (1) according to one of the claims 1 to 12, wherein
the first chamber (12) of the degassing device (11) has a downstream portion
30 having a cross-section selected with respect to a maximal blood flow rate in an extracorporeal blood circuit connected to the degassing device (11) so that the velocity of blood in the downstream portion of the first chamber (12) is less than a predetermined velocity.

14. A fluid distribution module (1) according to claim 13, wherein the cross-section of the downstream portion of the first chamber (12) is selected with respect to a maximal blood flow rate in an extracorporeal blood circuit of about 500ml/min so that the velocity of blood in the downstream portion of the first chamber (12) is less than about 3m/min.
15. A fluid distribution module (1) according to one of the claims 1 to 14, wherein the cross-section of the second chamber (14) of the degassing device (11) at the level of the passageway (72) is selected so that the ratio of the velocity of blood within a downstream portion of the first chamber (12) to the velocity of blood within the second chamber (14) at the level of the passageway (72) is more than a determined value.
16. A fluid distribution module (1) according to claim 15, wherein the cross-section of the second chamber (14) of the degassing device (11) at the level of the passageway (72) is selected so that the ratio of the velocity of blood within the downstream portion of the first chamber (12) to the velocity of blood within the second chamber (14) at the level of the passageway (72) is at least about 2.
17. A fluid distribution module (1) according to one of claims 1 to 16, wherein the downstream portion of the second chamber (14) of the degassing device (11) asymmetrically surrounds an upper part of the first chamber (12).
18. A fluid distribution module (1) according to claim 17, wherein the first chamber (12) comprises a downstream portion having a cylindrical wall (71) extending along a longitudinal axis (x) of the degassing device (11), and the downstream portion of the second chamber (14) comprises a cylindrical wall (73) partially surrounding the cylindrical wall (71) of the first chamber (12) and a bottom wall (74) that is beveled with respect to the longitudinal axis (x) of the degassing device (11).

19. A fluid distribution module (1) according to claim 18, wherein the cylindrical wall (71) of the first chamber (12) and the cylindrical wall (73) of the second chamber (14) are concentric.
- 5 20. A fluid distribution module (1) according to one of claims 1 to 19, wherein the passageway (72) has a lesser cross-section than a cross-section of the second chamber (14) so that a flow of liquid from the first chamber (12) into the second chamber (14) decreases within the second chamber (14).
- 10 21. A fluid distribution module (1) according to one of claims 1 to 20, wherein the first chamber (12), the second chamber (14) and the passageway (72) are arranged with respect to each other so that a flow pattern of a liquid flowing through the degassing device (11) comprises a component that is tangential to the hydrophobic membrane (78).
- 15 22. A fluid distribution module (1) according to one of claims 1 to 21, wherein the flow pattern of a liquid flowing through the degassing device (11) comprises an umbrella like component.
- 20 23. A fluid distribution module (1) according to one of the claims 1 to 22, wherein the first chamber (12), the second chamber (14) and the passageway (72) are arranged with respect to each other so that a liquid flowing through the degassing device (11) keeps gas bubbles in motion along an inner surface of the hydrophobic membrane (78).
- 25 24. A fluid distribution module (1) according to one of the claims 1 to 23, wherein the first chamber (12) comprises a downstream portion having a cross-section that is substantially the same as the cross-section of the passageway (72) between the first and the second chambers (12, 14).
- 30 25. A fluid distribution module (1) according to one of the claims 1 to 24, characterized in that the downstream portion of second chamber (14) forms an

overflow for a liquid flowing from the first chamber (12) into the second chamber (14).

26. A fluid distribution module (1) according to one of the claims 1 to 25, wherein
5 the upstream portion of the second chamber (14) has a decreasing cross-section, with a larger cross-section that is substantially level with the passageway (72) and a smaller cross-section that is substantially level with the hydrophobic membrane (78).
- 10 27. A fluid distribution module (1) according to one of the claims 1 to 26, wherein the outlet (15) opens in the second chamber (14) at a lowest point thereof.
28. An extracorporeal blood circuit comprising:
- a fluid distribution module (1) according to one of the claims 1 to 27;
 - 15 - a pump hose (2) having a first end connected to the second end of the fourth conduit (23) and a second end connected to the a first end of the fifth conduit (24);
 - a blood withdrawal tube (5) connected to a first end of the fourth conduit (23a, 23b);
 - a supply tube (4) to a blood treatment device connected to the second end of the
20 fifth conduit (24; 24a, 24b);
 - a discharge tube (7) from a treatment device connected to the first end of the first conduit (20); and
 - a blood return tube (6) connected to the second end of the second conduit (21).